

Warm-Up Problems. Find the unknown side length in each right triangle with legs a and b and hypotenuse c .

1. $a = 20, b = 21$

2. $b = 21, c = 35$

3. $a = 20, c = 52$

- I can develop and apply the formulas for the areas of triangles and special quadrilaterals.
- I can solve problems involving perimeters and areas of triangles and special quadrilaterals.

Common Core Standards

CC.9-12.A.SSE.1 Interpret expressions that represent a quantity in terms of its context.

CC.9-12.A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

7. What is the area addition postulate?
8. What is the formula for the area of a rectangle?
9. What is the formula for the area of a parallelogram?
10. What is the formula for the area of a square? How about the perimeter?

Remember!

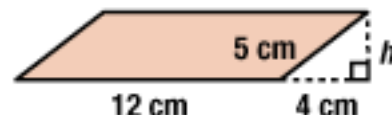
The height of a parallelogram is measured along a segment perpendicular to a line containing the base.

Remember!

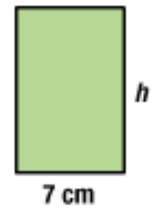
The perimeter of a rectangle with base b and height h is $P = 2b + 2h$ or
 $P = 2(b + h)$.

Video Example:

A) What is the area of the parallelogram?



B) What is the height of the rectangle?



Area: $14x + 7x^3 \text{ cm}^2$

C) What the perimeter of the rectangle?



Area: $34x^2 \text{ in}^2$

1

Finding Measurements of Parallelograms

Find each measurement.

A the area of the parallelogram

Step 1 Use the Pythagorean Theorem to find the height h .

$$3^2 + h^2 = 5^2$$

$$h = 4$$

Step 2 Use h to find the area of the parallelogram.

$$A = bh$$

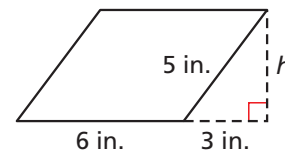
Area of a parallelogram

$$A = 6(4)$$

Substitute 6 for b and 4 for h .

$$A = 24 \text{ in}^2$$

Simplify.



Photographer: What are you doing in my darkroom?

Math Student: I'm waiting for my formula to develop!

"The bad news is time flies. The good news is you're the pilot."—*Personal Achievement Coach, Michael Altshuler*

Find each measurement.

B the height of a rectangle in which $b = 5$ cm and $A = (5x^2 - 5x)$ cm²

$$A = bh$$

Area of a rectangle

$$5x^2 - 5x = 5h$$

Substitute $5x^2 - 5x$ for A and 5 for b .

$$5(x^2 - x) = 5h$$

Factor 5 out of the expression for A .

$$x^2 - x = h$$

Divide both sides by 5.

$$h = (x^2 - x) \text{ cm}$$

Sym. Prop. of =

C the perimeter of the rectangle, in which $A = 12x$ ft²

Step 1 Use the area and the height to find the base.

$$A = bh$$

Area of a rectangle

$$12x = b(6)$$

Substitute $12x$ for A and 6 for h .

$$2x = b$$

Divide both sides by 6.

Step 2 Use the base and the height to find the perimeter.

$$P = 2b + 2h$$

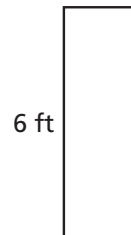
Perimeter of a rectangle

$$P = 2(2x) + 2(6)$$

Substitute $2x$ for b and 6 for h .

$$P = (4x + 12) \text{ ft.}$$

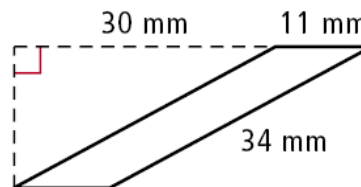
Simplify.



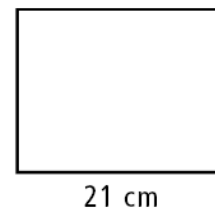
Example 1.

A. Find the area of the parallelogram.

B. Find the height of a rectangle in which $b = 3$ in. and $A = (6x^2 + 24x - 6)$ in².



C. Find the perimeter of the rectangle, in which $A = (79.8x^2 - 42)$ cm²



11. **Guided Practice:** Find the base of the parallelogram in which $h = 56$ yd and $A = 28$ yd².

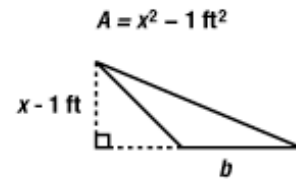
12. What is the formula for the area of a triangle?

13. What is the formula for the area of a trapezoid?

Video Example 2.

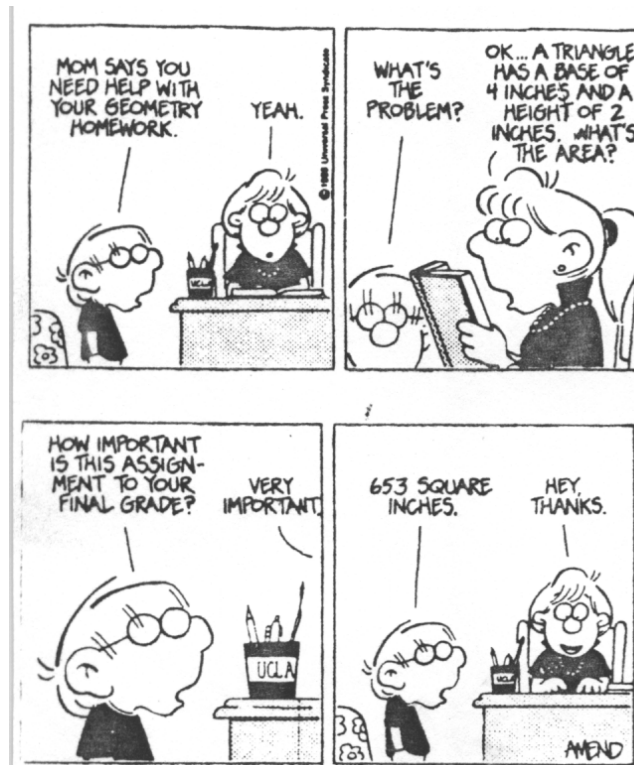
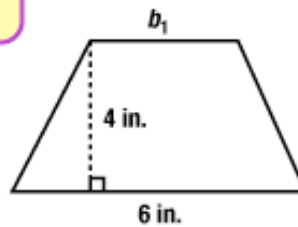
A) What is the area of a trapezoid in which $b_1 = 8 \text{ cm}$, $b_2 = 10 \text{ cm}$, and $h = 5 \text{ cm}$.

B) Find each measurement:



C) Find b_1 .

b_1 of the trapezoid, in which $A = 22 \text{ in}^2$



2 Finding Measurements of Triangles and Trapezoids

Find each measurement.

A the area of a trapezoid in which $b_1 = 9$ cm, $b_2 = 12$ cm, and $h = 3$ cm

$$A = \frac{1}{2}(b_1 + b_2)h \quad \text{Area of a trapezoid}$$

$$A = \frac{1}{2}(9 + 12)3 \quad \text{Substitute 9 for } b_1, 12 \text{ for } b_2, \text{ and 3 for } h.$$

$$A = 31.5 \text{ cm}^2 \quad \text{Simplify.}$$

Find each measurement.

B the base of the triangle, in which $A = x^2$ in²

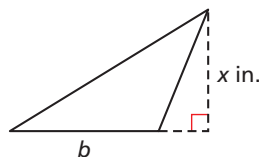
$$A = \frac{1}{2}bh \quad \text{Area of a triangle}$$

$$x^2 = \frac{1}{2}bx \quad \text{Substitute } x^2 \text{ for } A \text{ and } x \text{ for } h.$$

$$x = \frac{1}{2}b \quad \text{Divide both sides by } x.$$

$$2x = b \quad \text{Multiply both sides by 2.}$$

$$b = 2x \text{ in.} \quad \text{Sym. Prop. of } =$$



C b_2 of the trapezoid, in which $A = 8$ ft²

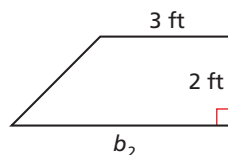
$$A = \frac{1}{2}(b_1 + b_2)h \quad \text{Area of a trapezoid}$$

$$8 = \frac{1}{2}(3 + b_2)(2) \quad \text{Substitute 8 for } A, 3 \text{ for } b_1, \text{ and 2 for } h.$$

$$8 = 3 + b_2 \quad \text{Multiply } \frac{1}{2} \text{ by 2.}$$

$$5 = b_2 \quad \text{Subtract 3 from both sides.}$$

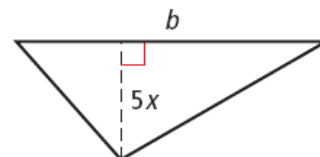
$$b_2 = 5 \text{ ft} \quad \text{Sym. Prop. of } =$$



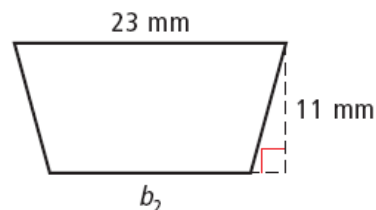
Example 2.

A. Find the area of a trapezoid in which $b_1 = 8$ in., $b_2 = 5$ in., and $h = 6.2$ in.

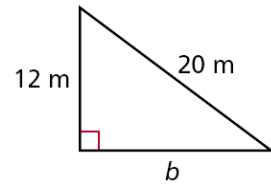
B. Find the base of the triangle, in which $A = (15x^2)$ cm².



C. Find b_2 of the trapezoid, in which $A = 231$ mm².



14. **Guided Practice.** Find the area of the triangle.



Remember!

The diagonals of a rhombus or kite are perpendicular, and the diagonals of a rhombus bisect each other.

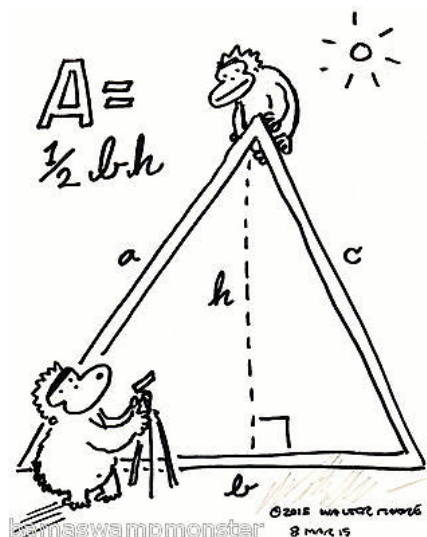
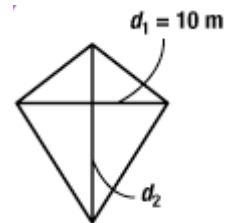
Remember!

The diagonals of a rhombus or kite are perpendicular, and the diagonals of a rhombus bisect each other.

15. What is the formula for the area of rhombus and/or kite?

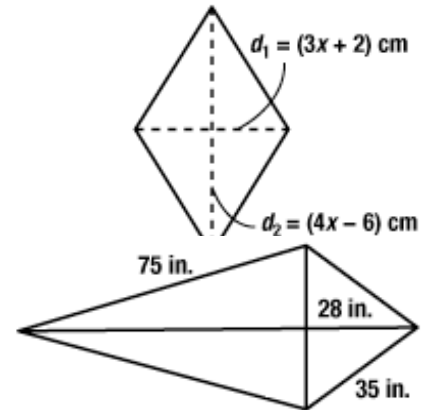
Video Example 3.

A) Find d_2 of a kite which $d_1 = 10\text{ m}$ and $A = 55\text{ m}^2$.



B) Find the area of the rhombus.

C) Find the area of the kite.



3 Finding Measurements of Rhombuses and Kites

Find each measurement.

A d_2 of a kite in which $d_1 = 16$ cm and $A = 48$ cm²

$$A = \frac{1}{2}d_1d_2 \quad \text{Area of a kite}$$

$$48 = \frac{1}{2}(16)d_2 \quad \text{Substitute 48 for } A \text{ and 16 for } d_1.$$

$$6 = d_2 \quad \text{Solve for } d_2.$$

$$d_2 = 6 \text{ cm} \quad \text{Sym. Prop. of =}$$



Find each measurement.

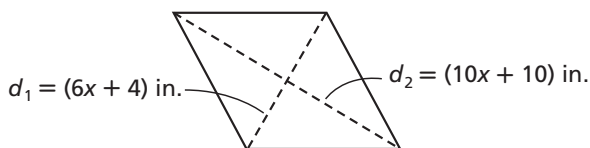
B the area of the rhombus

$$A = \frac{1}{2}d_1d_2$$

$$A = \frac{1}{2}(6x + 4)(10x + 10) \quad \text{Substitute } (6x + 4) \text{ for } d_1 \text{ and } (10x + 10) \text{ for } d_2.$$

$$A = \frac{1}{2}(60x^2 + 100x + 40) \quad \text{Multiply the binomials (FOIL).}$$

$$A = (30x^2 + 50x + 20) \text{ in}^2 \quad \text{Distrib. Prop.}$$



C the area of the kite

Step 1 The diagonals d_1 and d_2 form four right triangles. Use the Pythagorean Theorem to find x and y .

$$9^2 + x^2 = 41^2$$

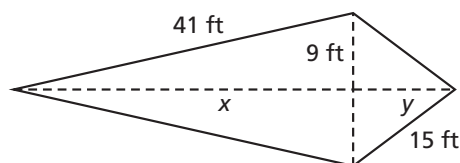
$$x^2 = 1600$$

$$x = 40$$

$$9^2 + y^2 = 15^2$$

$$y^2 = 144$$

$$y = 12$$



Step 2 Use d_1 and d_2 to find the area. d_1 is equal to $x + y$, which is 52. Half of d_2 is equal to 9, so d_2 is equal to 18.

$$A = \frac{1}{2}d_1d_2 \quad \text{Area of a kite}$$

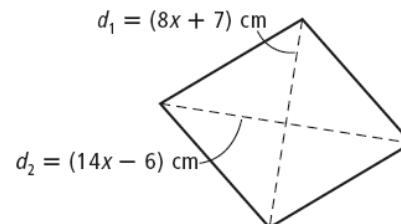
$$A = \frac{1}{2}(52)(18) \quad \text{Substitute 52 for } d_1 \text{ and 18 for } d_2.$$

$$A = 468 \text{ ft}^2 \quad \text{Simplify.}$$

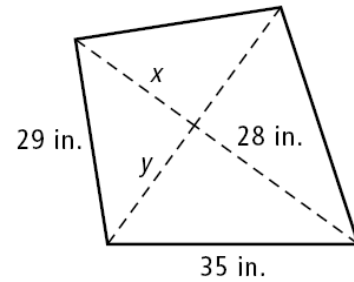
Example 3.

A. Find d_2 of a kite in which $d_1 = 14$ in. and $A = 238$ in².

B. Find the area of a rhombus.



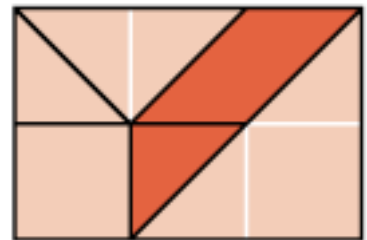
C. Find the area of the kite.



16. **Guided Practice:** Find d_2 of a rhombus in which $d_1 = 3x$ m and $A = 12xy$ m².

10-1 Developing Formulas for Triangles and Quadrilaterals (p 683) 11, 13, 15-17, 19.

Video Example 4: Some pieces of a tangram area arranged in a rectangle with dimensions 2 cm by 3 cm. Use the grid to find the perimeter and area of the dark trapezoid.



Oh yeah does this sound like some of the kids in your class?



"My teacher said I don't pay enough attention in class. At least, that's what I think she said."

4 Games Application

The pieces of a tangram are arranged in a square in which $s = 4$ cm. Use the grid to find the perimeter and area of the red square.

Perimeter:

Each side of the red square is the diagonal of a square of the grid. Each grid square has a side length of 1 cm, so the diagonal is $\sqrt{2}$ cm. The perimeter of the red square is $P = 4s = 4\sqrt{2}$ cm.

Area:

Method 1 The red square is also a rhombus. The diagonals d_1 and d_2 each measure 2 cm. So its area is

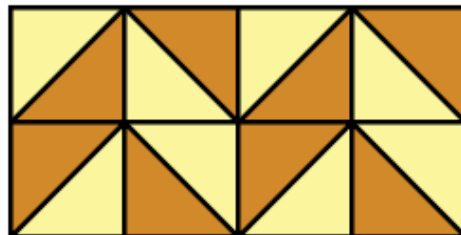
$$A = \frac{1}{2}d_1d_2 = \frac{1}{2}(2)(2) = 2 \text{ cm}^2.$$

Method 2 The side length of the red square is $\sqrt{2}$ cm, so the area is

$$A = s^2 = (\sqrt{2})^2 = 2 \text{ cm}^2.$$



Example 4. The tile design shown is a rectangle with a base of 4 in. and a height of 2 in. Use the grid to find the perimeter and area of the leftmost shaded parallelogram.



17. Guided Practice. In the tangram, find the perimeter and area of the large green triangle. Each grid square has a side length of 1 cm.



10-1 Developing Formulas for Triangles and Quadrilaterals (*p* 683) 11, 13, 15-17, 19, 21, 22, 24, 29, 32, 42, 43, 49-54.

